Patent claims

1. Device for transport of liquid developer to an image carrier element given electrophoretic digital printing

- in which a developer means (203) is arranged adjacent to the image carrier element (F), which developer means (203) directs a liquid developer comprising toner particles to the image carrier element (F) and from which developer means (203) toner particles cross over to the image carrier element (F) corresponding to the previously-generated potential images,
- in which a raster means (202) in whose rastering the liquid developer is transported to the developer means (203) is arranged adjacent to the developer means (203),
- in which a chamber scraper (201) comprising a dosing scraper (R2) is arranged adjacent to the raster means (202), from which chamber scraper (201) the raster means (202) accepts the liquid developer via the dosing scraper (R2) whose position relative to the raster means (202) is adjustable, and which chamber scraper (201) is designed such that the dosing scraper (R2) is overflowed by liquid developer.

2. Device according to claim 1,
in which the chamber scraper (201) is arranged relative to the raster means (202) such that the dosing scraper (R2) is overflowed by liquid developer due to gravity.

3. Device according to claim 1,
in which the liquid developer in the chamber scraper (201) is exposed to an over-pressure such that the dosing scraper (R2) is overflowed by liquid developer.

4. Device according to any of the claims 1 through 3,

in which a cleaning device (204, 205) is arranged adjacent to the developer means (203) for removal from the developer means (203) of the liquid developer comprising the inverse residual image, which cleaning device (204, 205) accepts the residual image.

5. Device according to claim 4,
in which the cleaning device comprises a cleaning roller (204).

6. Device according to claim 5,
in which the liquid developer is stripped from the cleaning roller (204) by a cleaning element (205), for example a scraper.

7. Device according to any of the claims 1 through 6,
in which the developer means (203) is a developer roller.

8. Device according to any of the preceding claims,
in which the raster means (202) is a raster roller.

9. Device according to claim 8,
in which the quantity of the liquid developer transported by the raster roller is established by the rastering of the raster roller (202).

10. Device according to any of the claims 7 through 9,
in which the developer roller (203), raster roller (202) and cleaning roller (204) rotate with constant speed ratios (surface velocities).

11. Device according to claim 10,
in which the developer roller (203), raster roller (202) and cleaning roller (204) rotate in a ratio of 1:1:1.

12. Device according to any of the claims 7 through 11,

in which the movement directions of the surfaces of developer roller (203) and image carrier element (F) are in the same direction or in opposing directions.

13. Device according to any of the claims 7 through 12, in which developer roller (203) and raster roller (202) rotate in the same direction or in opposing directions.

14. Device according to any of the claims 7 through 13, in which the developer roller (203) and cleaning roller (204) rotate in the same direction or in opposing directions.

15. Device according to any of the claims 7 through 14, in which an electrical potential for targeted field effect on the charged toner particles is respectively applied on developer roller (203) and image carrier element (F).

16. Device according to any of the claims 7 through 15, in which an electrical potential for targeted field effect on the charged toner particles is applied on developer roller (203) and cleaning roller (204).

17. Device according to any of the claims 7 through 16, in which the developer roller (203) comprises an elastic coating (206) that is in contact with the image carrier element (F), with the raster roller (202) and with the cleaning roller (204).

18. Device according to any of the claims 7 through 17, in which the transport of the liquid developer by the raster roller (202) is relative to the area and therewith independent of the printing speed, such that the same quantity of liquid developer per areal unit is always directed to the developer roller (203) given different printing speeds.

19. Device according to claim 18,
in which the raster roller (202) exhibits a rastering that enables the transport of a volume of liquid developer from 1 to 40 cm^3/m^2 (dependent on the roller surface), advantageously 5-20 cm^3/m^2.

20. Device according to any of the claims 7 through 19,
in which the developer roller (203) and the image carrier element (F) or, respectively, the developer roller (203) and the cleaning roller (204) or, respectively, the developer roller (203) and the raster roller (202) are arranged relative to one another such that defined effective zones form for the liquid developer.

21. Device according to claim 20,
in which the effective zone is formed via a defined deformation of the elastic coating (206) of the developer roller (203), advantageously via elastic force delivery to the adjacent elements (image carrier element (F); cleaning roller (204); raster roller (202)).

22. Device according to claim 20,
in which an incompressible layer of the liquid developer establishes the separation between developer roller (203) and image carrier element (F) or, respectively, developer roller (203) and cleaning roller (204) or, respectively, developer roller (203) and raster roller (202).

23. Device according to any of the claims 7 through 22,
in which the chamber scraper (201) comprises a chamber (207) situated on the circumferential surface of the raster roller (202), two scrapers (R1, R2) – one closing scraper (R1) at the entrance of the chamber (207) as viewed in the rotation direction of the raster roller (202), one dosing scraper (R2) at the exit of the chamber (207) as viewed in the rotation direction of the

raster roller (202) – sealing the chamber (207), and two seals laterally situated on the edge of the raster roller (202).

24. Device according to claim 23,
in which the feed of the liquid developer into the chamber (207) occurs via one or more inlet openings, advantageously via pumping.

25. Device according to claim 23 or 24,
in which the removal of the liquid developer from the chamber (207) occurs via inlet or outlet openings.

26. Device according to claim 25,
in which the inlet or outlet openings can be exchanged depending on the installation position relative to the raster roller (202).

27. Device according to any of the claims 23 through 26,
in which the angular position of the chamber scraper (201) relative to the raster roller (202) is limited in that the dosing scraper (R2) is located below the surface of the liquid developer in the chamber (207).

28. Device according to any of the claims 23 through 27,
in which the processing of a higher-viscosity liquid developer (for example 1000 mPa*S) is made easier via generation of a slight over-pressure in the chamber (207).

29. Device according to any of the claims 23 through 28,
in which the installation position of the chamber scraper (201) on the raster roller (202) is variable.

30. Device according to any of the claims 23 through 29,

in which the installation position of the cleaning device (204, 205) on the developer roller (203) is variable.

31. Electrophoretic printing device,
in which at least one device (developer station E) according to any of the claims 1 through 30 is provided for development of potential images on the image carrier element (F).

32. Electrophoretic printing device according to claim 31,
in which the developer roller (203), the raster roller (202) and the cleaning roller (204) are arranged in the developer station (E) at a constant angle relative to one another, such that the arrangement of developer stations (E) around the image carrier element (F) at various angular positions is possible without changing the association of developer roller (203), raster roller (202), cleaning roller (203 [sic]) relative to one another.

33. Electrophoretic printing device according to claim 31 or 32,
- in which printing modules (PM) respectively made up of a developer station (E) and an image carrier element (F) are provided,
- in which the developer roller (203), the raster roller (202) and the cleaning roller (204) are arranged in the developer station (E) at a constant angle relative to one another,
- in which the printing modules (PM) are arranged at various angular positions along a deflected recording medium (1), whereby the arrangement of chamber scraper (201), raster roller (202) and developer roller (203) relative to one another is maintained in the respective developer station (E).

34. Electrophoretic printing device according to claim 33,
in which a transfer roller (121) is arranged in the printing module between image carrier element (F) and recording medium (1).

35. Electrophoretic printing device according to claim 32, 33 or 34, in which the angular position of the developer stations (E) relative to the image carrier element (F) or, respectively, of the printing modules (PM) relative to the recording medium (1) can additionally be expanded by the possibility that the angular position of the chamber scraper (201) on the raster roller (202) is variable.

36. Electrophoretic printing device according to any of the claims 31 through 35, in which a plurality of developer stations (E) can be arranged in a digital color printing device.

37. Electrophoretic printing device according to any of the claims 31 through 36, in which identically designed developer stations (E1 – E5) can be used for different developer fluids (for example for different applications).

38. Method for transport of liquid developer to an image carrier element in electrophoretic digital printing, in which the feed of the liquid developer to the image carrier element (F) occurs via a device according to the claims 1 through 30.

39. Modularly-designed printing device that is suitable for realization of a design of the most varied, complex printing machines for professional digital high-speed printing,

- in which a printing system made up of a combination of a plurality of printing groups (100) arranged in series is provided with a common printing substrate guidance group (200, 300),

- in which machines of the printing substrate pre- or, respectively, post-processing are connected before the printing system or, respectively, after the printing system,
- in which a central control group (400) for coordination of the workflows in the printing groups (100) and in the printing substrate guidance group (200, 300) is provided.

40. Printing device according to claim 39, in which the printing groups (100) are executed as modules that can be combined with one another that are structurally identical, compact and easily manipulable.

41. Printing device according to claim 39 or 40, in which the printing groups (100) can be adapted to the width of the printing substrate (1).

42. Printing device according to claim 39, 40 or 41, in which the printing groups (100) are executed as electrographic printing groups.

43. Printing device according to claim 42, in which a printing group (100) respectively comprises a printing unit (110) with an image generation element (111), a charge station (112), an image exposure station (113), a developer station (114) and an image generation element cleaning station (115).

44. Printing device according to claim 43, in which the image generation element (111) comprises a photoconductor such as a photoconductor drum, a photoconductor belt.

45. Printing device according to claim 43 or 44,

in which the exposure station (113) is an LED character generator or a laser.

46. Printing device according to any of the claims 43 through 45, in which the developer station (114) is an electrophoretic liquid developer station.

47. Printing device according to claim 46, in which the developer station (114) comprises a developer roller (202) that transports a liquid developer past the image generation element (111) such that the toner deposition on the image generation element (111) is independent of its speed.

48. Printing device according to claim 47, in which a high-ohmic carrier fluid in which toner particles are dispersed is provided as a liquid developer.

49. Printing device according to claim 48, in which the carrier fluid is silicon oil.

50. Printing device according to any of the claims 39 through 49 with a developer station

- in which a developer roller (203) is arranged adjacent to the image carrier element (111), which developer roller (203) directs a liquid developer comprising toner particles to the image carrier element (111) and from which developer roller (203) toner particles cross over to the image carrier element (111) corresponding to the previously-generated potential images,
- in which a raster roller (202) in whose rastering the liquid developer is transported to the developer roller (203) is arranged adjacent to the developer roller (203),

- in which a chamber scraper (201) comprising a dosing scraper (R2) is arranged adjacent to the raster roller (202), from which chamber scraper (201) the raster roller (202) accepts the liquid developer via the dosing scraper (R2) whose position relative to the raster roller (202) is adjustable, and which chamber scraper (201) is designed such that the dosing scraper (R2) is overflowed by liquid developer.

51. Printing device according to any of the claims 39 through 50, in which the printing group (100) respectively comprises a transfer unit (120)
- with a transfer element (121), advantageously with a transfer roller or a transfer belt,
- with a transfer printing station (123) with one or more rollers.

52. Printing device according to claim 51, in which the transfer printing station (123) is combined with transfer printing auxiliary means, advantageously with a corona device.

53. Printing device according to claim 51 or 52, in which the transfer unit (120) comprises a toner image conditioner station (122), advantageously a roller or a belt in contact with the transfer element (121), if applicable electrical adjustable or temperable.

54. Printing device according to any of the claims 51 through 54, in which the transfer unit (120) comprises a cleaning station (124) for cleaning of the transfer element (121), which cleaning station (124) comprises a blade, roller or fleece cleaner.

55. Printing device according to any of the claims 39 through 54, in which the printing group (100) comprises a printing group activation unit (130),

- with a power electronic (131) that is associated with the motor controllers and high voltage supplies of the printing unit (110) or, respectively, transfer unit (120),
- with a digital electronic (132, for example microprocessor controller) for realization of process regulations in cooperation with the central control group (400), advantageously signal processing including interface controller to sensors of the printing unit (110) or, respectively, the transfer unit (120).

56. Printing device according to any of the claims 39 through 55, in which the printing group (100) comprises an additional and auxiliary process unit (140),
- with an ink means feed station (141),
- and/or with a printing substrate conditioner station (142), advantageously for paper moistening,
- and/or with a filter and suction station (143), advantageously for the developer station or for the corona device.

57. Printing device according to any of the claims 39 through 56, in which the printing group (100) comprises an image data processing unit (150, controller).

58. Printing device according to any of the claims 39 through 57, in which the printing substrate guidance group (200) is suitable for continuous printing substrate webs ("continuous feet" [sic]),
- with a printing substrate web tension generation station (211),
- and/or with a printing substrate web alignment station (212),
- and/or with a printing substrate web extraction station (213).

59. Printing device according to claim 58,

in which the printing substrate web tension generation station (211) is a negative pressure brake or an Omega draw that is arranged at the input of the printing system.

60. Printing device according to claim 58 or 59,
in which the printing substrate web alignment station (212) is a pivoting frame that is arranged at the input of the printing system.

61. Printing device according to any of the claims 58 through 60,
in which the printing substrate web extraction station (213) is a transport roller pair that is arranged at the output of the printing system.

62. Printing device according to any of the claims 39 through 61,
in which at least one print image conditioner unit (230) is provided.

63. Printing device according to claim 62,
in which respectively one unit for intermediate fixing (231) is arranged as a print image conditioner unit between the printing groups (100).

64. Printing device according to claim 62 or 63,
in which a fixing station (232) (advantageously an IR radiation fixing or heat-pressure fixing) is provided at the output of the printing system.

65. Printing device according to any of the claims 39 through 64,
in which a gloss station (233) is provided at the output of the printing system.

66. Printing device according to any of the claims 39 through 65,
in which the printing substrate guidance group (200) comprises at least one electronic activation unit (240)

- with a power electronic (241), advantageously for motor controllers and high voltage supplies,
- and/or with a digital electronic (242, for example microprocessor controller) for realization of the regulatory workflows for control or regulation of the printing substrate guidance in cooperation with the central control group (400) and/or for signal processing, including control of the interfaces to sensors of the printing substrate guidance group (200), the printing substrate guidance units (220) including the transfer printing unit(s) (221) as well as the print image conditioner units (230).

67. Printing device according to any of the claims 39 through 66, in which at least one printing substrate guidance group (300) for single sheet/sheet printing is provided.

68. Printing device according to claim 67, in which the printing substrate guidance group (300) for single sheet/sheet printing comprises a transport belt (311) on which the individual sheets or sheets rest.

69. Printing device according to any of the claims 39 through 68, in which a central control group (400) is provided.

70. Printing device according to claim 69, in which the central control group (400) comprises

- a central power electronic (410),
- at least one central electronic printer activation unit (420).
- and/or an interface (421) to the printing substrate pre- and post-processing,
- and/or an interface (422) to the printing groups (100),

- and/or an interface (424) to the printing substrate guidance group (200 or 300),
- and/or the central printer controller (425) for timely coordination of all workflows in the printing system as well as the entire printing path.

71. Printing device according to claim 70,
in which the central power electronic (410) comprises a mains voltage switching and safety system as well as the central power supply of the printing system.

72. Electrographic printing device comprised of an image generating system that generates an electrical charge image on an image carrier element, which electronic charge image is made visible by means of a developer station via charged ink particles (toner particles) and is subsequently transferred onto a final image medium and fixed on this, in which the speed of the image carrier element (F) is continuously variable from 0 up to a limit speed without impairment of the print quality on the final image medium (1).

73. Printing device according to claim 72,
in which the charge intensity is adapted with regard to the speed of the image carrier element (F).

74. Printing device according to claim 72 or 73,
in which the electronic character generation is adapted to the speed of the image carrier element (F) with regard to the information location and energy per area, such that in the electrographic process the charge image (with regard to form and potential values) is always created in the same manner independent of the speed of the image carrier element (F).

75. Printing device according to any of the claims 72 through 74, in which the developer station is designed such that the signal distribution on the image carrier element (F) is developed independent of its speed, such that during the development process identical potential distributions on the image carrier element (F) always generate the same toner distributions on the charge images.

76. Printing device according to claim 75, in which the process parameters (such as photoconductor potential, light energy, auxiliary potential across the developer gap, toner concentration) are variable for the case that the development of the charge image is not entirely independent of the speed of the image carrier element (F), such that the toner image deposition on the image carrier element (F) is nearly identical at different speeds.

77. Printing device according to any of the claims 71 through 76, in which the process parameters (such as auxiliary potential between image carrier element (F) and final image medium (1), between image carrier element (F) and intermediate carrier, between intermediate carrier and final image medium (1)) are variable for the case that the transfer of the toner image onto the final image medium (1) directly or, respectively, via an intermediate carrier is not entirely independent of the speed of the image carrier element (F), such that the toner image deposition on the image carrier element (F) is nearly identical at different speeds.

78. Printing device according to claim 76 or 77, in which the process parameters to be influenced are coupled with one another via one or more regulatory processes.

79. Printing device according to any of the claims 72 through 78,

in which the inking of the image medium (F) by the developer station occurs according to the electrophoretic principle.

80. Printing device according to claim 79,
in which a developer roller (203) is provided in the developer station (200), which developer roller (203) transports a liquid developer past the image carrier element (F) such that the toner deposition in the image carrier element (F) is independent of its speed.

81. Printing device according to claim 80,
in which a high-ohmic carrier fluid in which toner particles are dispersed is provided as a liquid developer.

82. Printing device according to claim 81,
in which the carrier fluid is silicon oil.

83. Printing device according to claim 81 or 82,
in which the toner particles advantageously exhibit a diameter of approximately 1 μm.

84. Printing device according to any of the claims 72 through 83,
in which the toner concentration in the liquid developer is selected such that so many toner particles are located in the developer gap between developer roller (203) and image carrier element (F) that all toner particles located in the developer gap create the desired inking of the charge images given complete deposition.

85. Printing device according to claim 84,
in which the developer gap is advantageously 5 to 10 μm.

86. Printing device according to claim 84 or 85,

in which the mobility of the toner particles in the developer gap is such that, during the residence duration of the toner particles in the developer gap, optimally all toner particles under the influence of the electrical field strength existing over the image carrier element to be inked traverse the developer gap and are deposited on the surface of the image carrier element to be inked.

87. Printing device according to any of the claims 72 through 86 with a developer station

- in which a developer roller (203) is arranged adjacent to the image carrier element (F), which developer roller (203) directs liquid developer comprising the toner particles past the image carrier element (F) and from which developer roller (203) toner particles cross over to the image carrier element (F) corresponding to the previously-generated charge images,
- in which a raster roller (202) is arranged adjacent to the developer roller (203), in the rastering of which raster roller (202) the liquid developer is transported to the developer roller (203),
- in which a chamber scraper (201) comprising a dosing scraper (R2) is arranged adjacent to the raster roller (202), from which chamber scraper (201) the raster roller (202) accepts the liquid developer via the dosing scraper (R2), the position of which chamber scraper (201) is adjustable relative to the raster roller (202) and which chamber scraper (201) is designed such that the dosing scraper (R2) is overflowed by liquid developer.

88. Printing device according to claim 87,
in which the chamber scraper (201) is arranged relative to the raster roller (202) such that the dosing scraper (R2) is overflowed by liquid developer due to gravity.

89. Printing device according to claim 87 or 88,
in which the liquid developer in the chamber scraper (201) is exposed to an over-pressure such that the dosing scraper (R2) is overflowed by liquid developer.

90. Printing device according to any of the claims 80 through 89,
in which a cleaning device (204, 205) is arranged adjacent to the developer roller (203) for removal from the developer roller (203) of the liquid developer comprising the inverse residual image, which cleaning device (204, 205) accepts the residual image.

91. Printing device according to claim 90,
in which the cleaning device comprises a cleaning roller (204) and a cleaning element (205), for example a scraper, that strips the liquid developer from the cleaning roller.

92. Printing device according to any of the claims 87 through 91,
in which the transport of the liquid developer by the raster roller (202) is relative to the area and therewith independent of the printing speed, such that the same quantity of liquid developer per areal unit is always directed to the developer roller (203) given different printing speeds.

93. Printing device according to claim 92,
in which the quantity of the liquid developer transported by the raster roller is established by the rastering of the raster roller (202).

94. Printing device according to claim 93
in which the raster roller (202) exhibits a rastering that enables the transport of a volume of liquid developer from 1 to 40 cm^3/m^2 (dependent on the roller surface).

95. Printing device according to any of the claims 87 through 94, in which the developer roller (203), raster roller (202) and cleaning roller (204) rotate with constant speed ratios (surface velocities).

96. Printing device according to claim 95, in which the developer roller (203), raster roller (202) and cleaning roller (204) rotate in a ratio of 1:1:1.

97. Printing device according to any of the claims 87 through 96m in which the developer roller (203) comprises an elastic coating (206) that is in contact with the image carrier element (F), with the raster roller (202) and with the cleaning roller (204).

98. Printing device according to any of the claims 87 through 97, in which the chamber scraper (201) comprises a chamber (207) situated on the circumferential surface of the raster roller (202), two scrapers (R1, R2) – one closing scraper (R1) at the entrance of the chamber (207) as viewed in the rotation direction of the raster roller (202), one dosing scraper (R2) at the exit of the chamber (207) as viewed in the rotation direction of the raster roller (202) – sealing the chamber (207), and two seals laterally situated on the edge of the raster roller (202).

99. Printing device according to claim 98, in which the feed of the liquid developer into the chamber (207) occurs via one or more inlet openings, advantageously via pumping.

100. Printing device according to claim 98 or 99, in which the removal of the liquid developer from the chamber (207) occurs via inlet or outlet openings.

101. Method for operation of an electrophotographic printing device with variable printing speed using a printing device according to the claims 72 through 100.

102. Method according to claim 101,
in which the electronic character generation is adapted to the speed of the image carrier element (F) such that, in the electrographic process, the charge image (with regard to form and potential values) is always created in the same manner independent of the speed of the image carrier element (F).

103. Method according to claim 101 or 102,
in which the charge intensity is adapted (with regard to information location and energy per area) to the speed of the image carrier element (F).

104. Method according to any of the claims 101 through 103,
in which the developer station is designed such that the signal distribution on the image carrier element (F) is developed independent of its speed, such that during the development process identical potential distributions on the image carrier element (F) always generate the same toner distributions on the charge images.

105. Method according to claim 104,
in which the process parameters (such as photoconductor potential, light energy, auxiliary potential across the developer gap, toner concentration) are varied for the case that the development of the charge image is not entirely independent of the speed of an image carrier element (F), such that the toner image deposition is nearly identical given different speeds of the image carrier element (F).

106. Method according to any of the claims 101 through 105,

in which the process parameters (such as auxiliary potential between image carrier element (F) and final image medium, between image carrier element (F) and intermediate carrier, between intermediate carrier and final image medium) are varied for the case that the transfer of the toner image onto the final image medium (1) directly or, respectively, via an intermediate carrier is not entirely independent of the speed of the image carrier element (F), such that the toner image deposition on the final image medium is nearly identical at different speeds.

107. Method according to claim 105 or 106,
in which the process parameters to be influenced are coupled with one another via a regulatory process or a plurality of regulatory processes.

108. Method according to any of the claims 101 through 107,
in which the potential images on the image carrier element (F) are developed according to the electrophoretic principle.

109. Method according to claim 108,
in which a developer roller (203) in the developer station (E) transports a liquid developer past the image carrier element (F) such that the toner deposition in the image carrier element (F) is independent of its speed.

110. Method according to claim 109,
in which the toner concentration in the liquid developer is selected such that so many toner particles are located in the developer gap between developer roller (203) and image carrier element (F) that the desired inking of the charge images is created given complete deposition of all toner particles located in the developer gap.

111. Printing device according to claim 109 or 110,

in which the mobility of the toner particles in the developer gap is such that, during the residence duration of the toner particles in the developer gap, optimally all toner particles under the influence of the electrical field strength existing over the image carrier element to be inked traverse the developer gap and are deposited on the surface of the image carrier element (F) to be inked.